

APPLICATION

FOR UNITED STATES LETTERS PATENT

SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT WE, **Gregory S. Geschke**, a citizen of the United States, **William C. Gustafson**, a citizen of the United States, and **Alan B. Roberts**, a citizen of the United States, have invented a new and useful input/output transition board system of which the following is a specification:

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2
3
4 **Input/Output Transition Board System**
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6

7 **CROSS REFERENCE TO RELATED APPLICATIONS**
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9 Not applicable to this application.
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11
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13 **STATEMENT REGARDING FEDERALLY**
14 **SPONSORED RESEARCH OR DEVELOPMENT**
15

16 This invention was made with Government support under Contract No. N68335-00-
17 D-0451 awarded by Naval Air Systems Command. The Government has certain rights in
18 this invention.
19

20 **BACKGROUND OF THE INVENTION**
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22
23

24 **Field of the Invention**
25

26 The present invention relates generally to input/output (I/O) boards and more
27 specifically it relates to an input/output transition board system for collecting and
28 distributing input/output signals between a backplane and an I/O board while allowing
29 for additional electronic devices.
30

Description of the Related Art

Conventional backplanes have been in use for years upon various electronic units. Backplanes typically include a plurality of sockets that receive a corresponding number of cards. Some backplanes include a plurality of rear panel connectors that are in direct communication with the sockets. Exemplary backplane technologies include VME (VersaModule Eurocard), PCI (Peripheral Component Interconnect), cPCI (compact PCI) and related backplane technologies.

In thermal management applications (e.g. spray cooling, air cooling), an enclosure surrounds the electronic devices being thermally managed. I/O connectors are required to allow for the connection of external electronic devices. The I/O connectors are typically directly wired to the backplane with numerous wires (not shown). There are typically hundreds and sometimes thousands of wires required for all of the I/O connectors (each I/O connector typically has between 10 – 150 contacts). This wire configuration is time consuming to make and install. In addition, the wire configuration does not provide reliable impedance and is prone to failure (e.g. solder breakage, wire abrasion). Also, the wire configuration requires a significant amount of space within the enclosure.

To solve the inherent problems with wire configurations, ISOTHERMAL SYSTEMS RESEARCH, INC. developed an I/O board that is in direct communication between the I/O connectors and a backplane as shown in Figure 1 of the drawings. This configuration eliminates the usage of numerous wire connections between the I/O connectors and the backplane. However, there is a need for additional electronic devices and functionality to be included within the enclosure without significantly increasing the size of the enclosure (e.g. transceivers, Ethernet physical layer, current limiters, power sources, individual resets for selected backplane slots).

1
2 While these devices may be suitable for the particular purpose to which they
3 address, they are not as suitable for collecting and distributing input/output signals
4 between a backplane and an I/O board while allowing for additional electronic devices.
5 Conventional electronic communication systems for I/O connectors and a backplane do
6 not allow for additional electronic devices and functionality.

7
8 In these respects, the input/output transition board system according to the
9 present invention substantially departs from the conventional concepts and designs of
10 the prior art, and in so doing provides an apparatus primarily developed for the
11 purpose of collecting and distributing input/output signals between a backplane and an
12 I/O board while allowing for additional electronic devices.

1

2 **BRIEF SUMMARY OF THE INVENTION**

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4 In view of the foregoing disadvantages inherent in the known types of
5 backplane and I/O board connections now present in the prior art, the present invention
6 provides a new input/output transition board system construction wherein the same can
7 be utilized for collecting and distributing input/output signals between a backplane and
8 an I/O board while allowing for additional electronic devices.

9

10 The general purpose of the present invention, which will be described
11 subsequently in greater detail, is to provide a new input/output transition board system
12 that has many of the advantages of the backplane and I/O board connections mentioned
13 heretofore and many novel features that result in a new input/output transition board
14 system which is not anticipated, rendered obvious, suggested, or even implied by any
15 of the prior art backplane and I/O board connections, either alone or in any
16 combination thereof.

17

18 To attain this, the present invention generally comprises a transition board
19 having at least one front connector and at least one rear connector. The front
20 connector is connectable to a corresponding rear panel connector within a backplane.
21 The rear connector is connectable to a corresponding front I/O connector of an I/O
22 board. The transition board collects and passes the signals between the I/O board and
23 the backplane. The transition board is also preferably active with additional electronic
24 devices connected to the transition board.

25

26 There has thus been outlined, rather broadly, the more important features of the
27 invention in order that the detailed description thereof may be better understood, and
28 in order that the present contribution to the art may be better appreciated. There are
29 additional features of the invention that will be described hereinafter and that will form

1 the subject matter of the claims appended hereto.

2
3 In this respect, before explaining at least one embodiment of the invention in
4 detail, it is to be understood that the invention is not limited in its application to the
5 details of construction and to the arrangements of the components set forth in the
6 following description or illustrated in the drawings. The invention is capable of other
7 embodiments and of being practiced and carried out in various ways. Also, it is to be
8 understood that the phraseology and terminology employed herein are for the purpose
9 of the description and should not be regarded as limiting.

10
11 A primary object of the present invention is to provide an input/output
12 transition board system that will overcome the shortcomings of the prior art devices.

13
14 A second object is to provide an input/output transition board system for
15 collecting and distributing input/output signals between a backplane and an I/O board
16 while allowing for additional electronic devices.

17
18 Another object is to provide an input/output transition board system that allows
19 for attachment of accessory devices such as but not limited to transceivers, voltage and
20 current regulators, filters, receivers, transmitters, port monitors and the like.

21
22 An additional object is to provide an input/output transition board system that
23 significantly reduces the usage of discrete wiring.

24
25 A further object is to provide an input/output transition board system that
26 provides reliable impedance and communications.

27
28 Another object is to provide an input/output transition board system that is
29 resistant to communication disruption.

1
2 A further object is to provide an input/output transition board system that is
3 efficient and economical to manufacture and assemble.
4

5 Another object is to provide an input/output transition board system that
6 minimizes the required size of an enclosure.
7

8 A further object is to provide an input/output transition board system that
9 allows for the usage of commercial off the shelf cards and backplane boards.
10

11 Other objects and advantages of the present invention will become obvious to the
12 reader and it is intended that these objects and advantages are within the scope of the
13 present invention.
14

15 To the accomplishment of the above and related objects, this invention may be
16 embodied in the form illustrated in the accompanying drawings, attention being called
17 to the fact, however, that the drawings are illustrative only, and that changes may be
18 made in the specific construction illustrated and described within the scope of the
19 appended claims.

1
2 **BRIEF DESCRIPTION OF THE DRAWINGS**
3

4 Various other objects, features and attendant advantages of the present
5 invention will become fully appreciated as the same becomes better understood when
6 considered in conjunction with the accompanying drawings, in which like reference
7 characters designate the same or similar parts throughout the several views, and
8 wherein:
9

10 FIG. 1 is a top view illustrating an exemplary prior art backplane connected to
11 an I/O board.
12

13 FIG. 2 is an upper perspective view of the present invention.
14

15 FIG. 3 is an exploded upper perspective view of the present invention.
16

17 FIG. 4 is a top view of the present invention.
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19 FIG. 5 is an exploded top view of the present invention.
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21 FIG. 6 is an upper perspective view of an alternative embodiment of the present
22 invention.
23

24 FIG. 7 is an exploded upper perspective view of the alternative embodiment.
25

26 FIG. 8 is a top view of the alternative embodiment.
27

28 FIG. 9 is an exploded top view of the alternative embodiment.
29

1 FIG. 10 is a top view of a second alternative embodiment of the present
2 invention disclosing a plurality of auxiliary boards.

DETAILED DESCRIPTION OF THE INVENTION

A. Overview

Turning now descriptively to the drawings, in which similar reference characters denote similar elements throughout the several views, FIGS. 2 through 10 illustrate an input/output transition board system 10, which comprises a transition board 70 having at least one front connector 72 and at least one rear connector 73. The front connector 72 is connectable to a corresponding rear panel connector within a backplane. The rear connector 73 is connectable to a corresponding front I/O connector 22 of an I/O board 20. The transition board 70 collects and passes the signals between the I/O board 20 and the backplane. The transition board 70 is also preferably active with additional electronic devices 74 connected to the transition board 70. The I/O board 20, the transition board 70 and the backplane board 60 are preferably substantially parallel to one another in order to reduce the size necessary for the enclosure 14.

B. Enclosure

An enclosure 14 preferably surrounds the I/O board 20, the transition board 70 and the backplane board 60 along with the cards 12 connected to the backplane board 60. The I/O connectors are extendable through a wall of the enclosure 14 as best illustrated in Figures 4 and 5 of the drawings. In addition, the I/O board 20 preferably attached to an inner surface of the enclosure 14 as further shown in Figures 4 and 5 of the drawings.

A card cage may be utilized within the enclosure 14 to support the cards 12 as is well known in the art. U.S. Patent No. 5,880,931 illustrates an exemplary card cage for enclosures 14 and is incorporated by reference.

1 The enclosure **14** may be comprised of various structures commonly utilized to
2 retain electronics. The enclosure **14** may be comprised of air-cooled, liquid cooled or
3 spray cooled structures which are well known in the art. The enclosure **14** may be
4 comprised of a sealed or non-sealed structure.

5 6 **C. I/O Board**

7 The I/O board **20** may be comprised of any conventional I/O board **20** capable
8 of transferring communications which are well known in the art. The I/O board **20** is
9 preferably attachable to an interior surface of an enclosure **14** as shown in Figures 4
10 and 5 of the drawings. The I/O board **20** may be distally spaced from the inner surface
11 of the enclosure **14**, however this distance is preferably less than 1.0 inch.

12
13 The I/O board **20** has one or more rear I/O connectors **50** that provide an
14 electrical communications pathway into the interior of the enclosure **14** as illustrated in
15 Figures 3, 4 and 5 of the drawings. The rear I/O connectors **50** are preferably hermetic
16 and extend through a wall of the enclosure **14** in a sealed manner as further shown in
17 Figures 4 and 5 of the drawings. Each of the rear I/O connectors **50** preferably
18 includes at least about 10 - 150 electrical conductors; however the rear I/O connectors
19 **50** may have less than 10 - 150 electrical conductors.

20
21 As shown in Figures 2 through 10 of the drawings, one or more front I/O
22 connectors **22** are connected to the I/O board **20** for transferring communications from
23 the I/O board **20** to the transition board **70**. The front I/O connectors **22** may be
24 positioned in various locations upon the side of the I/O board **20** opposite of the I/O
25 connectors. It is preferable to first determine the positions of the rear I/O connectors
26 **50** upon the I/O board **20** before determining the locations of the front I/O connectors
27 **22**. It is also possible to have the front I/O connectors **22** positioned on opposite ends
28 of the I/O board **20** to provide a central space with respect to the transition board **70** to
29 allow space for accessory devices **74** as shown in Figures 3 through 5 of the drawings.

1
2 In addition, a space between the I/O board 20 and the transition board 70 also
3 provides room for solder connections with the rear I/O connectors 50. The solder
4 connections may be comprised of a socket type structure that receive pins from the I/O
5 connectors 50.

6
7 The front I/O connectors 22 and the rear I/O connectors 50 are preferably
8 comprised of a high density connector structure having a plurality of electrical
9 conductors (e.g. male, female). The front I/O connectors 22 and the rear I/O
10 connectors 50 are electrically connected to circuits within the I/O board 20 for
11 transferring the data between the rear I/O connectors 50 and the front I/O connectors
12 22.

13 14 ***D. Transition Board***

15 The transition board 70 provides additional space for the addition of accessory
16 devices 74 between the I/O board 20 and the backplane board 60. The transition board
17 70 may be comprised of any conventional circuit board structure. The transition board
18 70 is also preferably active since the purpose of the transition board 70 is to not only
19 transfer data between the backplane board 60 and the I/O board 20, but to also
20 manipulate, monitor or modify this data midstream.

21
22 The transition board 70 includes one or more rear connectors 73 connected to
23 the front I/O connectors 22 as shown in Figures 4 and 5 of the drawings. The rear
24 connectors 73 are comprised of a connector structure similar to the front I/O
25 connectors 22 and are positioned upon the transition board 70 in order to align with the
26 I/O connectors. As can be appreciated, the connectors 22, 32, 62, 72, 73 may be
27 comprised of any connector structure capable of transferring electrical
28 communications.

1 The transition board **70** further includes one or more front connectors **72**
2 connected to the rear backplane connectors **62** of the backplane board **60** as shown in
3 Figures 4 and 5 of the drawings. The front connectors **72** are comprised of a connector
4 structure similar to the rear backplane connectors **62** and are positioned upon the
5 transition board **70** in order to align with the rear backplane connectors **62**.

6
7 The rear connectors **73** and the front connectors **72** of the transition board **70**
8 may be positioned in a spaced apart relationship to provide space for the accessory
9 devices **74** positioned between thereof as shown in Figures 7, 8, 9 and 10 of the
10 drawings. However, the front connectors **72** may be positioned near one another
11 particularly if the backplane board **60** has a plurality of rear panel connectors as shown
12 in Figures 3, 4 and 5 of the drawings.

13
14 The transition board **70** is preferably distally spaced a distance from the
15 backplane board **60** and a distance from the I/O board **20** as shown in Figures 4, 8 and
16 10 of the drawings. The distance is preferably between about 0.4 to 1.0 inch which
17 provides sufficient space between the boards **20**, **60**, **70** to receive the one or more
18 accessory devices **74** connected to the transition board **70**.

19
20 The accessory devices **74** may be comprised of various electronic devices **74**
21 such as but not limited to transceivers, receivers, transmitters, voltage regulators,
22 current regulators, power sources, filters, port monitors, microprocessors, memory,
23 crossbar switch for I/O assignment, and individual resets for selected backplane slots.
24 The accessory devices **74** are electrically connected to circuits within the transition
25 board **70**. The accessory devices **74** may also manipulate data received from either the
26 I/O board **20** or the backplane board **60**.

1 **E. *Backplane Board***

2 The backplane board **60** may be comprised of any conventional backplane
3 board **60** configuration such as but not limited to VME (VersaModule Eurocard), PCI
4 (Peripheral Component Interconnect), cPCI (compact PCI). The backplane board **60** has
5 one or more rear backplane connectors **62** connected to the front connectors **72** of the
6 transition board **70** as shown in Figures 4 and 5 of the drawings.

7
8 In addition, the backplane board **60** preferably has one or more sockets **64** for
9 receiving one or more cards **12**. The sockets **64** are on a side opposite of the rear
10 backplane connectors **62** as shown in Figures 4 and 5 of the drawings. The sockets **64**
11 are preferably in communication with the rear backplane connectors **62**, where the rear
12 backplane connectors **62** are comprised of a rear panel connector structure to allow for
13 pass through communications between the sockets **64** and the rear backplane
14 connectors **62**.

15
16 **F. *Auxiliary Board***

17 As shown in Figure 10, at least one first auxiliary connector **32** is connected to
18 the backplane board **60** for receiving a first auxiliary board **30**. In addition, at least
19 one second auxiliary connector **32** may be connected to the first auxiliary board **30** and
20 a second auxiliary board **30** is connected to the second auxiliary connector **32**. The
21 auxiliary boards **30** may be comprised of any circuit board architecture and may
22 include one or more electronic devices **74**. The auxiliary boards **30** may also include
23 I/O connectors that extend through the enclosure **14** as shown in Figure 10 of the
24 drawings. The auxiliary boards **30** may extend about the interior perimeter of the
25 enclosure **14** as further shown in Figure 10 of the drawings.

26
27 What has been described and illustrated herein is a preferred embodiment of the
28 invention along with some of its variations. The terms, descriptions and figures used
29 herein are set forth by way of illustration only and are not meant as limitations. Those

1 skilled in the art will recognize that many variations are possible within the spirit and
2 scope of the invention, which is intended to be defined by the following claims (and
3 their equivalents) in which all terms are meant in their broadest reasonable sense
4 unless otherwise indicated. Any headings utilized within the description are for
5 convenience only and have no legal or limiting effect.